

P.12 GRAVITY WAVE CLIMATOLOGY AT MIDLATITUDE FROM RAYLEIGH LIDAR DATA

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Atmospheric sounding of the middle atmosphere by Rayleigh scattering has been performed in France for several years, from two stations with different orographic situations: one in the Alps, the Observatoire de Haute Provence (44°N, 6°E), one on the Atlantic coast at Biscarosse (44°N, 1°W). The vertical profiles of density and temperature are obtained with a temporal and spatial resolution of, respectively, 15 mn and 300 m between 30 and 80 km. A statistical study of the atmospheric fluctuations due to gravity waves has been performed and the main results of this study will be presented: climatology of the gravity wave activity, distribution of energy versus vertical wave number and altitude, comparison of the observations at the two sites. Conclusions will be presented on the saturation of the wave field, the filtering by the mean wind, the transfer of energy and momentum into the atmosphere.

Climatology

Data base

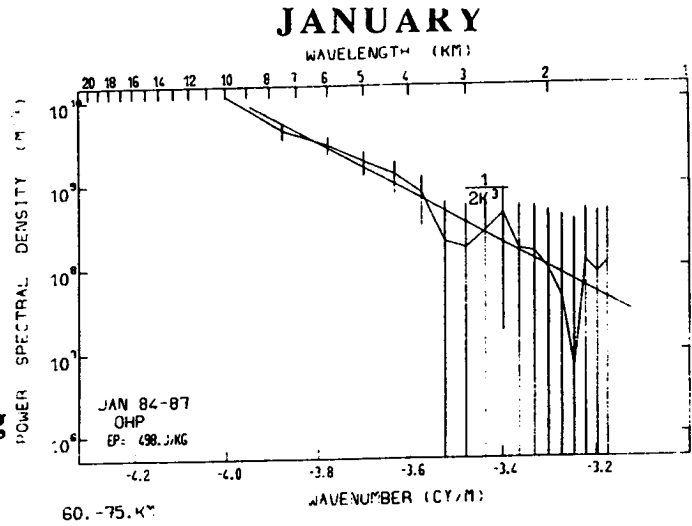
This study is based upon the monthly means of either the power spectral density (Figures 1, 2, 3) and of the variance obtained by demodulation (Figures 4, 5). The data based extended over 4 years at O.H.P. and 2 years at Biscarosse. The fluctuations of temperature are associated with vertical displacement of air, then are related to the potential energy of the wave field which is used here to define the "activity".

Main results

- The amplitude of the temperature fluctuations are far from the (convective) saturation value in the stratosphere, in all seasons and for wavelength greater than 1 km. In the lower mesosphere (45-60 km), the saturation value is reached for waves smaller than 2-3 km wavelength. In the upper mesosphere (60-75 km) the wave field is completely saturated in a statistical sense for wavelengths up to 8 km, especially in winter.
- The climatology exhibits essentially the same features at the two stations (Figures 4,5). Nevertheless the activity is weaker at Biscarosse in winter, and identical during summer and equinoxes after the reversal of the zonal wind (Figures 6,7).
- In the stratosphere the activity presents a clear annual variation with a maximum in winter, a minimum in summer, with a seasonal ratio of 3.
- In the mesosphere an annual variability is also observed but less pronounced. The seasonal ratio is 1.5. A weak semiannual component is also present with a minimum of activity during the equinoxes.

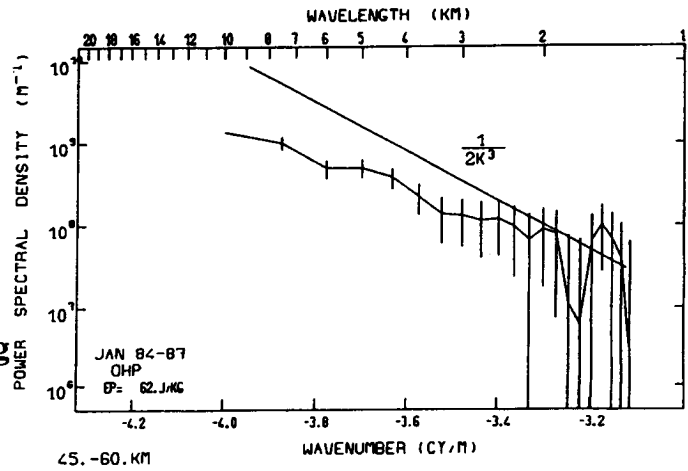
60-75 Km

$E_p = 498 \text{ J/Kg}$



45-60 Km

$E_p = 62 \text{ J/Kg}$



30-45 Km

$E_p = 27 \text{ J/Kg}$

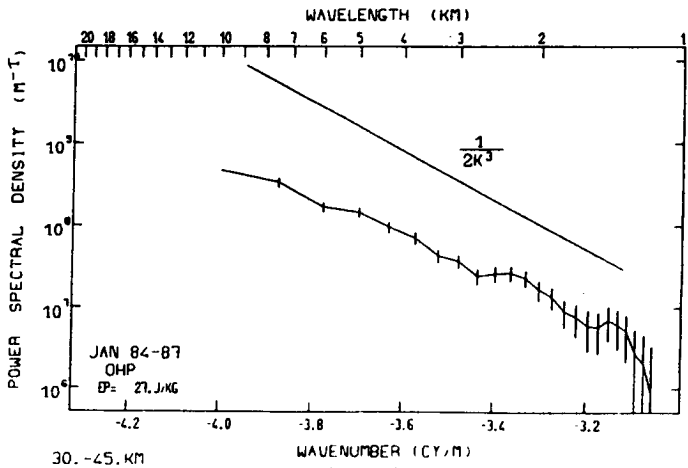
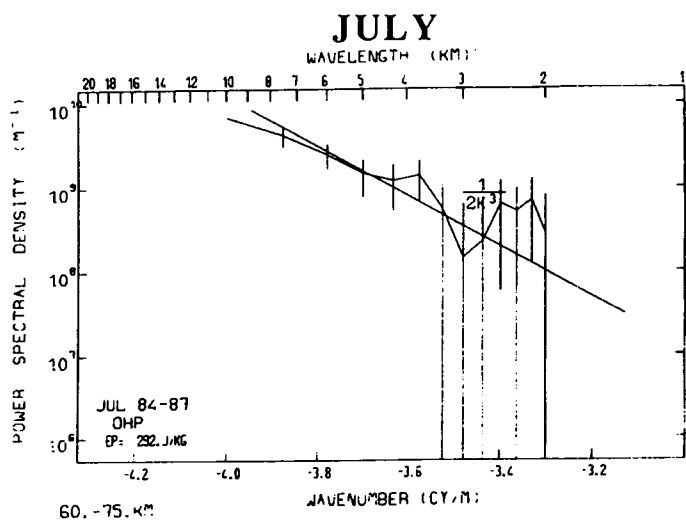
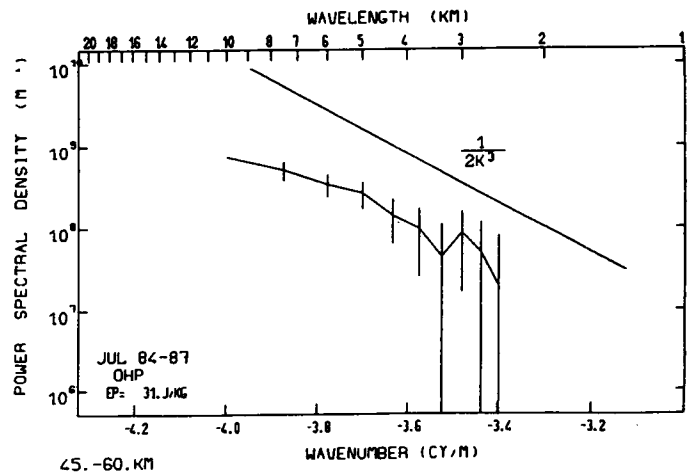


Figure 1.

60-75 Km
Ep=292J/Kg



45-60 Km
Ep=31 J/Kg



30-45 Km
Ep= 8 J/Kg

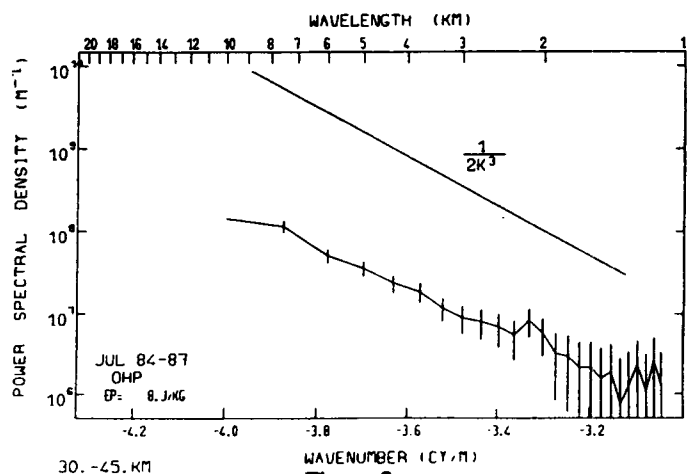
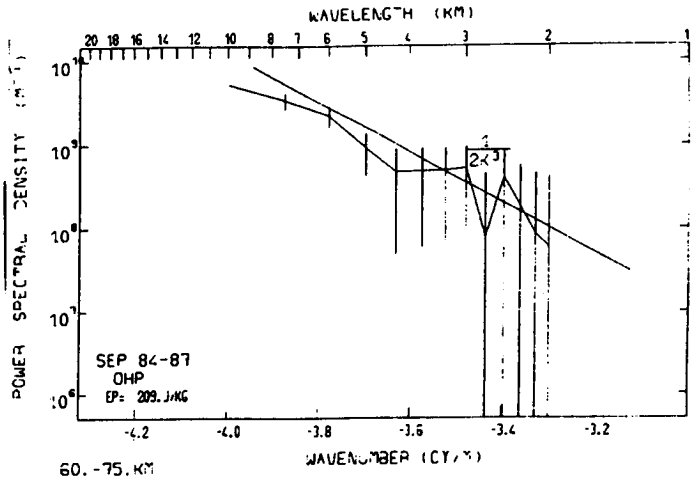


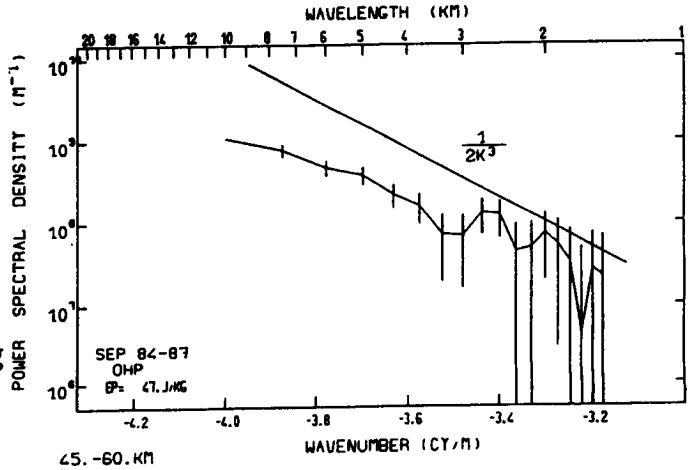
Figure 2.

SEPTEMBER

60-75 Km
 $E_p=209 \text{ J/Kg}$



45-60 Km
 $E_p=47 \text{ J/Kg}$



30-45 Km
 $E_p=8 \text{ J/Kg}$

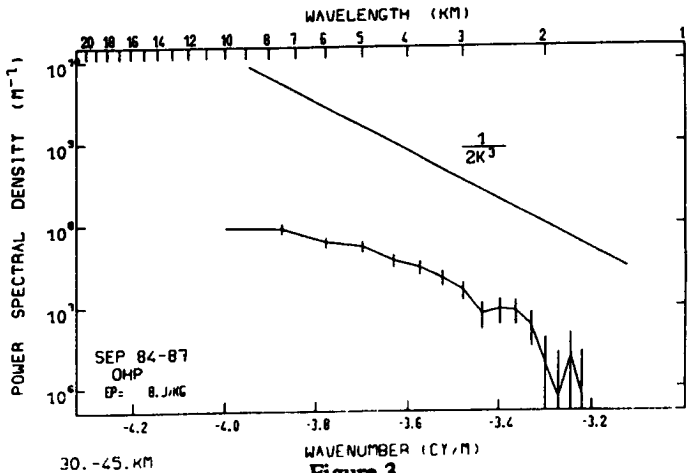


Figure 3.

Seasonal variation of the variance at O.H.P. for $\lambda = 8$ km

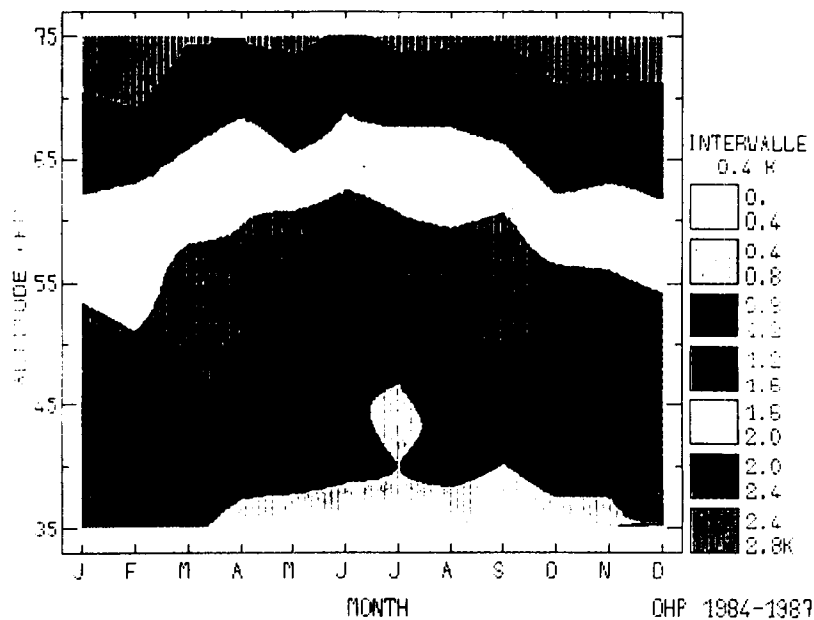


Figure 4.

Seasonal variation of the variance at Biscarosse for $\lambda = 8$ km

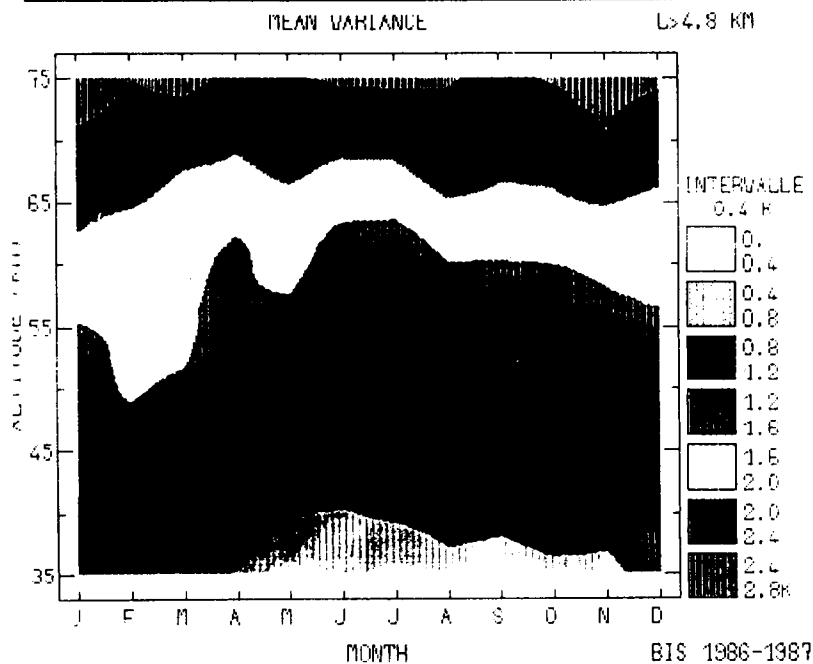


Figure 5.

Comparison of power spectral density for July at the two stations.

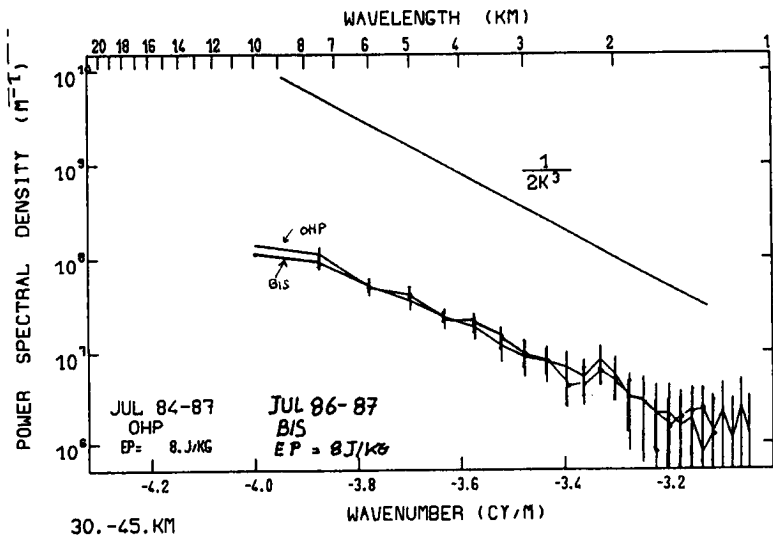


Figure 6.

Comparison of power spectral density for January at the two stations.

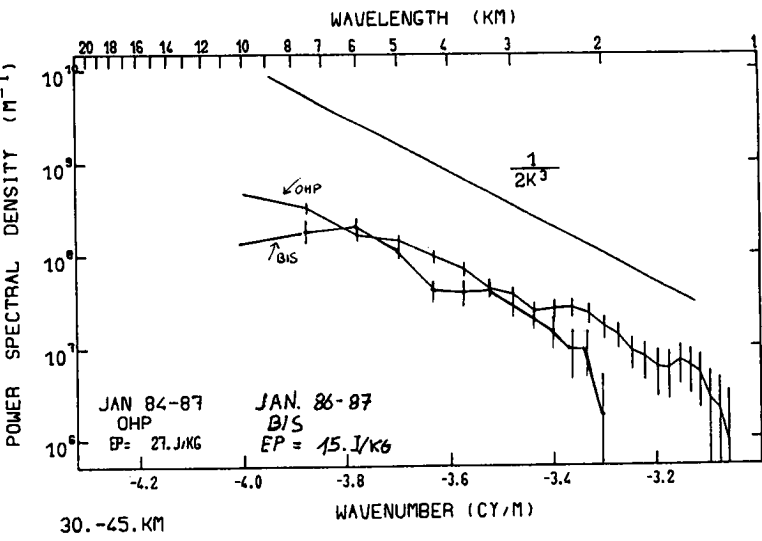
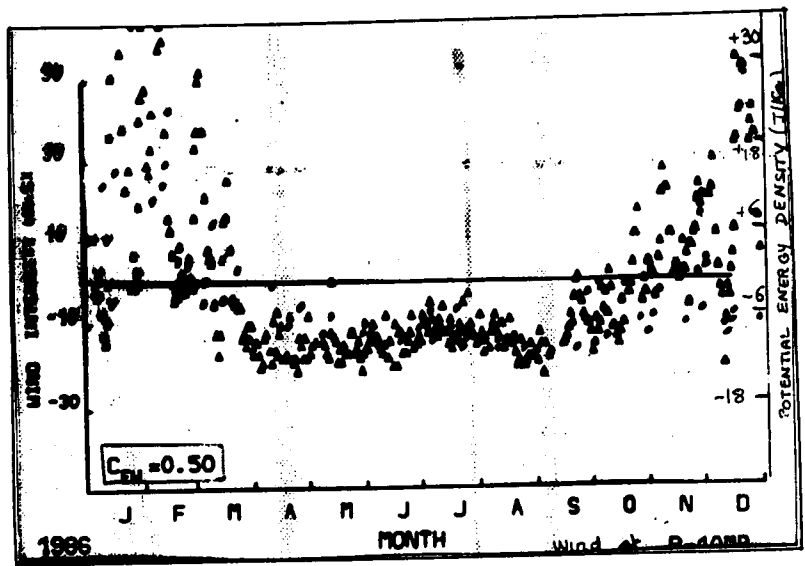


Figure 7.

Seasonal variation of potential energy density and zonal mean wind at 10 mb (from N.M.C.)



The correlation coefficient is 0.5

Figure 8.

ranges compared with a spectral model

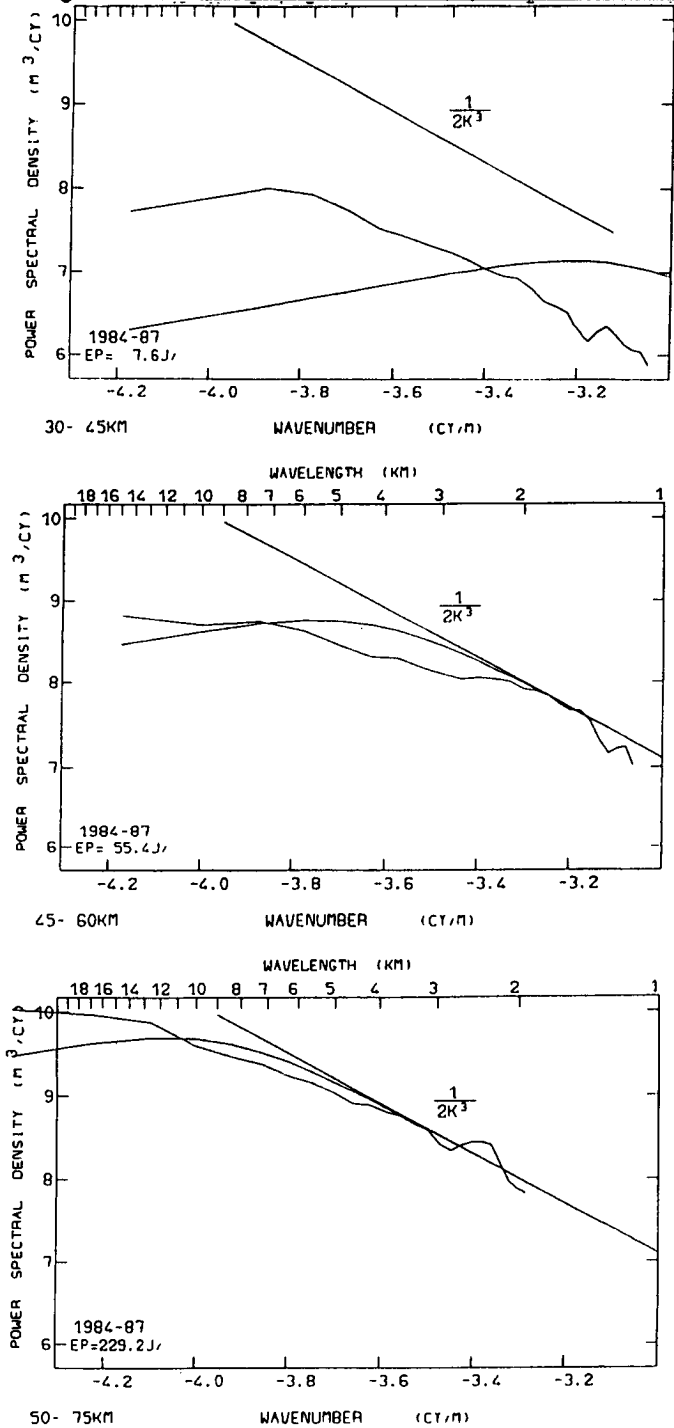


Figure 9.

Variance of temperature fluctuations as a function of altitude
($\lambda = 8 \text{ km}$)

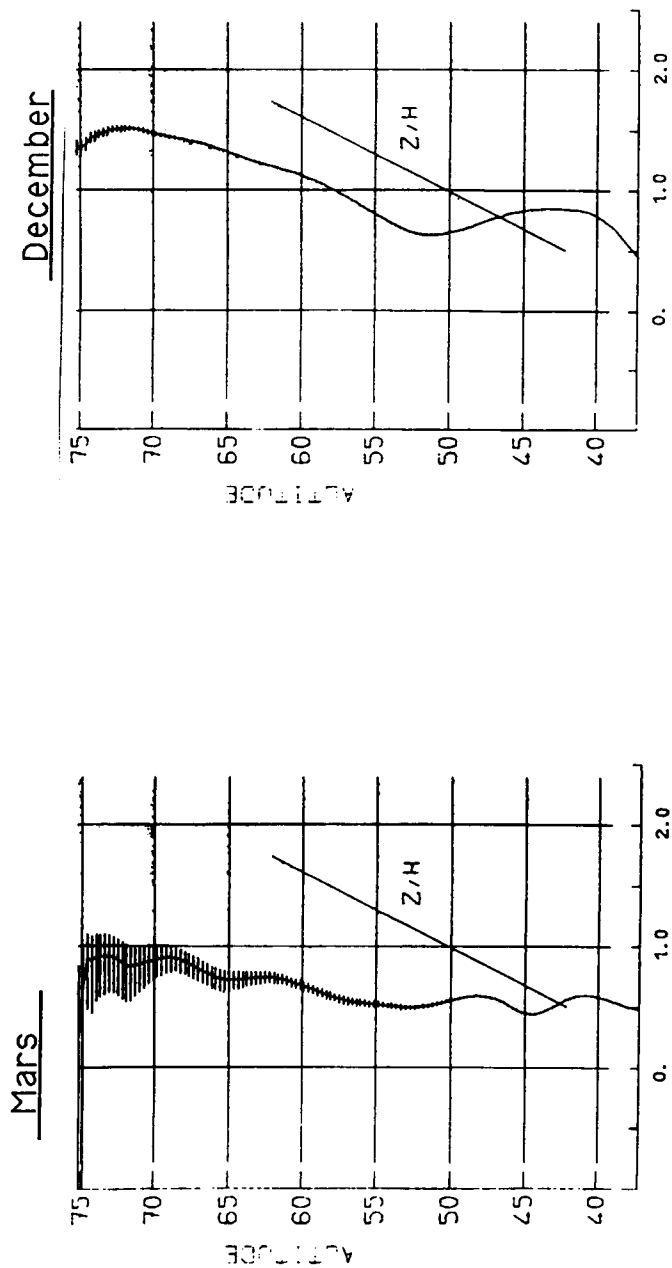


Figure 10.